NASA TECH BRIEF

Goddard Space Flight Center

Spectrometer

The problem:

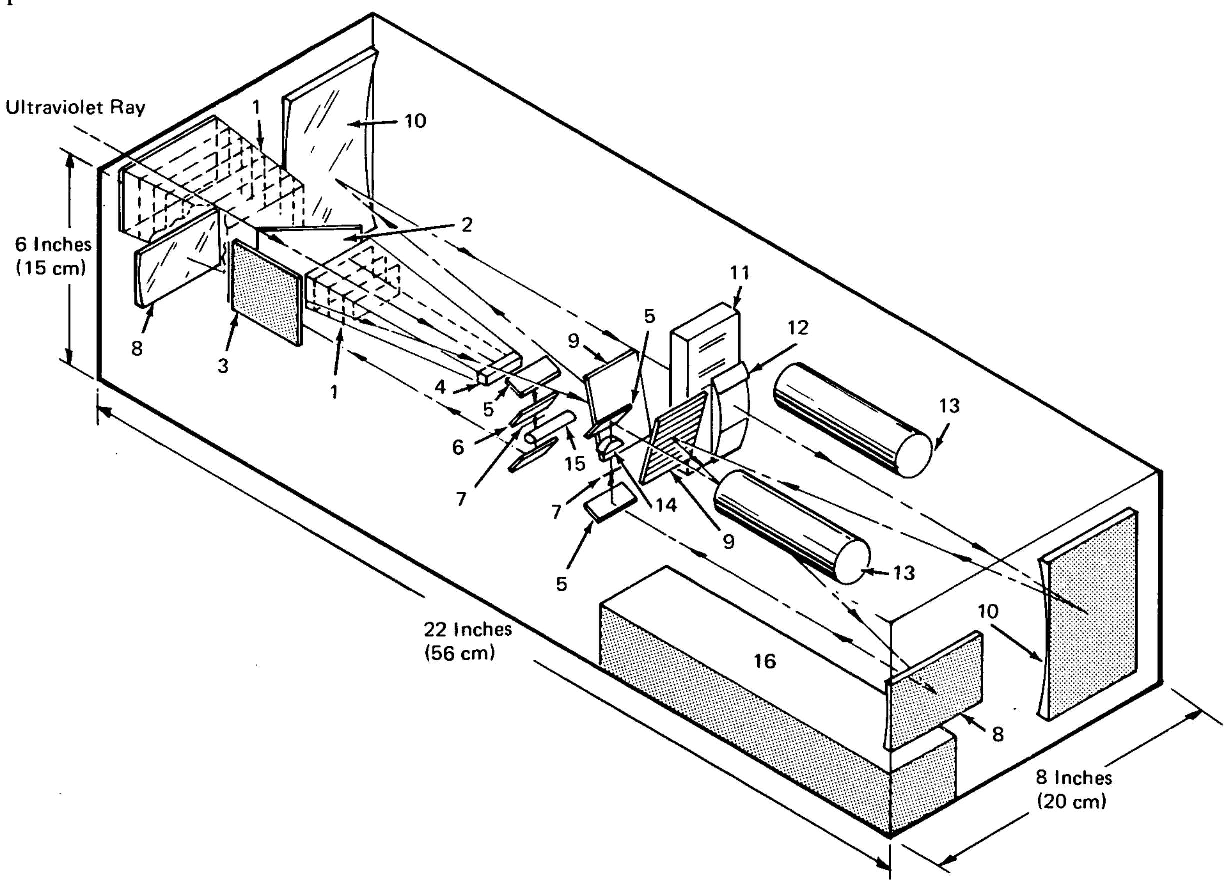
Standard scanning spectrometers are not suitable for the study of discrete wavelengths in narrow spectral regions. This stems from the fact that these spectrometers accept radiation contaminated with scattered light. Accurate measurements of specific wavelengths are, therefore, difficult to realize.

The solution:

An ultraviolet spectrometer has been developed which can measure pure monochromatic wavelengths in predetermined narrow wave bands.

How it's done:

The spectrometer incorporates two stages. The first stage, a conventional spectrometer, produces a stationary dispersed beam which is intercepted by an array of slits cut into a plate at discrete wavelength locations. The second stage is an inverted spectrometer identical with the first which recombines the dispersed spectrum at a single exit slit. In addition to providing greater spectral purity by the rejection of scattered light, the second stage enables the use of a single photomultiplier detector.



Spectrometer

(continued overleaf)

The ultraviolet spectrum is examined between 250 and 340 nm at 12 discrete wavelengths in 1-nm bandwidths. A thirteenth wavelength is observed in a 2-nm bandwidth with a separate photomultiplier detector for the purpose of obtaining a background measurement. This design readily lends itself to the use of a thirteenth slit which eliminates the need for another optical system, the transmission filter, another diffuser system, and an entrance baffle.

Referring to the figure, an ultraviolet ray enters the baffle (1), and with the mirror (2) folded against the window (3), it enters the depolarizer (4). The ray is folded 180° by the two mirrors (5). The calibration mirror (6) is pivoted out of the ray path at this time. Between the two folding mirrors is the entrance slit (7), through which the ray passes. After folding, the ray passes to the parabolic mirror (8), and is reflected to the first grating (9). From the grating, the dispersed ray is reflected to parabolic mirror (10), which reflects it to the intermediate slit plate and shutter system (11). The shutter selects the desired wavelength. The ray at a selected wavelength passes through a field flattening lens (12), to the parabolic mirror (10), at the right side of the figure.

From mirror (10), the ray is reflected to the second grating (9), where it is dispersed in opposition to the first grating allowing the light to pass through the exit slit after reflection off of the right-hand parabolic mirror (10), and the lower 90° folding mirror (5). After passing through the exit slit the ray is folded again through 90° to aline it with the entrance of the lower photomultiplier (13). The field lens (14), enables the ray to fill the detector target to reduce gain changes due to nonhomogeneous emission of electrons over the target area.

Calibration of the system is accomplished by placing mirror (6) to cut off the light from mirror (5). Mirror (6) receives light from the argon source (15) and reflects it through the system starting at the lower folding mirror (5).

Power supplies for the detectors and argon lamp are located in housing (16).

Notes:

1. Although designed for ultraviolet range, this spectrometer can be easily modified for visible and infrared spectra.
2. Requests for further information may be directed to:
   Technology Utilization Officer
   Goddard Space Flight Center
   Code 207.1
   Greenbelt, Maryland 20771
   Reference: TSP74-10181

Patent status:

NASA has decided not to apply for a patent.

Source: Donald H. Menzel of
Geophysics Corporation of America
under contract to
Goddard Space Flight Center
(GSC-11694)